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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART XIV NUCLEAR POWER PLANTS

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ELECTROTECHNICAL VOCABULARY

PART XIV NUCLEAR POWER PLANTS

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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART XIV NUCLEAR POWER PLANTS

0. FOREWORD

0.1 This Indian Standard (Part XIV) was adopted by the Indian Standards Institution on 15 March 1967, after the draft finalized by the Electrotechnical Standards Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard (Part XIV) follows, to a large extent, the definitions included in the draft recommendation by the International Electrotechnical Commission as contained in Doc: 1 (26) (Central Office) 238 which represents the consensus of international opinion on the subject.

0.3 It has not been found possible to prepare the electrotechnical vocabulary as a complete volume which is, therefore, being issued in several parts each having one or more sections. Other parts are given in Appendix A.

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1. SCOPE

1.1 This standard (Part XIV) covers definitions of terms applicable to nuclear power plants for generation of electric energy.

2. NUCLEAR PHYSICS

2.1 General

2.1.1 *Atom* — The smallest part of an element, with no net electric charge, which can participate in chemical combinations.

2.1.2 *Ion* — An atom, molecule or group of molecules having a net electric charge.

2.1.3 *Nucleus* — The central part of an atom, possessing a positive charge and containing nearly all the mass of the atom.

2.1.4 *Compound Nucleus* — The expression used in Bohr theory to define the excited nucleus formed when a particle is absorbed by a nucleus during a nuclear reaction.

2.1.5 *Mass Number* — Total number of protons and neutrons in a nuclide.

2.1.6 *Atomic Number* — Number of protons contained in the nucleus.

2.1.7 *Nuclide* — A species of atom characterized by its mass number, atomic number, and nuclear energy state, provided that the mean life in that state is long enough to be observable.

2.1.8 *Isotopes* — Nuclides having the same atomic number but different mass numbers.

2.1.9 *Isotopic Abundance* — Ratio of the number of atoms of a specified isotope of an element to the total number of atoms of this element in a sample. Expressed in percent.

2.1.10 *Abundance Ratio* — Quotient of two isotopic abundance in a given element.

2.1.11 *Radionuclide* — A radioactive nuclide.

2.1.12 *Radioisotope* — Radioactive isotope.

2.1.13 *Parent; Radioactive Precursor* (*of a Radionuclide*) — Radioactive nuclide which produces the radionuclide by one or several successive disintegrations.

2.1.14 *Decay Product* — Nuclide originating from the disintegration of a radioactive nuclide.

2.1.15 *Fission Fragments* — The nuclei resulting from fission before they have undergone radioactive transformations.

2.1.16 *Fission Products* — The nuclides produced either by fission or by the subsequent radioactive disintegration of the nuclides thus formed.

2.1.17 *Radioelement* — Radioactive chemical element.

2.1.18 *Alpha, Beta and/or Gamma Emitter* — Radionuclide disintegrating with emission of alpha, beta and/or gamma radiation.

2.1.19 *Active Deposit* — Radioactive products deposited on a surface following radioactive decay of gas.

2.1.20 *Radiation* — The emission of energy in the form of particles of matter or in the form of an electromagnetic wave.

2.1.21 *Alpha Particle* — A helium-4 nucleus emitted during a nuclear transformation; by extension, any helium-4 nucleus.

2.1.22 *Alpha-Radiation* — Alpha particles emerging from radioactive atoms.

2.1.23 *Electron* — An elementary particle having the smallest known charge of negative electricity. Its mass is $9{\cdot}108 \times 10^{-28}$ gram. The charge of electron $e = 1{\cdot}6 \times 10^{-20}$ emu.

2.1.24 *Beta Particle* — An electron of either positive charge ($\beta+$) or negative charge ($\beta-$), which has been emitted by an atomic nucleus or neutron in the process of a radioactive transformation.

2.1.25 *Positron* — It is identical to electron but has positive charge.

2.1.26 *Beta Disintegration* — Radioactive transformation of a nuclide or neutron in which the atomic number changes by ± 1, and the mass number remains constant. Increase of atomic number occurs with negative beta particle emission, decrease with positive beta particle (positron) emission or upon electron capture.

2.1.27 *Beta-Ray Spectrum* — Distribution, in energy or in momentum, of beta particles (not including conversion electrons) emitted by beta disintegration process.

2.1.28 *Electron-Positron Pair* — Electron and positron simultaneously created, in a process called 'pair production'.

2.1.29 *Photon* — Quantum of electromagnetic radiation.

2.1.30 *X-Radiation* — An electromagnetic radiation produced by interaction of an electron with the coulomb field of a nucleus or by orbital electron transitions.

2.1.31 *Gamma Radiation* — Electromagnetic radiation emitted in the process of nuclear transition or particle annihilation.

2.1.32 *Capture Gamma Radiation* — Gamma radiation emitted immediately after the capture of a neutron by a nuclide.

2.1.33 *Prompt Gamma Radiation* — Gamma radiation accompanying the fission process without measurable delay.

2.1.34 *Bremsstrahlung* — The electromagnetic radiation associated with the deceleration or acceleration of charged particles.

2.1.35 *Photoelectron* — Electron emitted by some metals in a phenomenon called photoelectric effect.

2.1.36 *Photoneutron* — Neutron emitted during a photonuclear reaction.

2.1.37 *Nucleon* — A proton or a neutron.

2.1.38 *Proton* — An elementary particle carrying the smallest charge of positive electricity and having a mass near that of the hydrogen atom. The mass of the proton is $m_p = 1{\cdot}672 \times 10^{-24}$ gram $= 1{\cdot}007\ 59$ atomic mass units.

2.1.39 *Neutron* — An elementary particle with no charge, having a mass of $1{\cdot}675 \times 10^{-24}$ gram or 1·008 98 atomic mass units.

2.1.40 *Neutron Excess* — Number of neutrons in a nucleus in excess of the number of protons.

2.1.41 *Fission Neutrons* — Neutrons originating in the fission process (including both prompt and delayed neutrons) which have retained their original energy.

NOTE — The restriction of this term to neutrons with fission spectrum is essential (*see* **2.2.57**).

2.1.42 *Prompt Neutrons* — Neutrons emitted only during the process of fission and do not include neutrons emitted by fission products in the process of their chain decay.

2.1.43 *Delayed Neutrons* — Neutrons emitted by fission products in the process of their chain decay.

2.1.44 *Fast Neutrons* — Neutrons of kinetic energy greater than some specified value. This value may vary over a wide range and will be dependent upon the application, such as reactor physics, shielding, or dosimetry. In reactor physics the value is frequently chosen to be 0·1 MeV.

2.1.45 *Intermediate Neutrons* — Neutrons of kinetic energy between the energies of slow and fast neutrons. In reactor physics the range might be 1 eV to 0·1 MeV.

2.1.46 *Resonance Neutrons* — Intermediate energy neutrons having energies from eV region to keV region, in which resonance of fissile and fertile materials lie.

2.1.47 *Epicadmium Neutrons* — Neutrons of kinetic energy greater than the cadmium cut-off energy.

2.1.48 *Cadmium Cut-Off* — Neutron energy value below which the transmission factor through a cadmium sheet of specified thickness can be considered negligible.

2.1.49 *Effective Cadmium Cut-Off* — That energy value which, for a given experimental configuration, is determined by the condition that, if a cadmium cover surrounding a detector were replaced by a fictitious cover opaque to neutrons with energy below this value and transparent to neutrons with energy above this value, the observed detector response would be unchanged.

2.1.50 *Subcadmium Neutrons* — Neutrons of kinetic energy less than the cadmium cut-off energy.

2.1.51 *Slow Neutrons* — Neutrons of kinetic energy less than some specified value. This value may vary over a wide range and will depend on the application, such as reactor physics, shielding, or dosimetry. In reactor physics the value is frequently chosen to be 1 eV; in dosimetry the cadmium cut-off energy is used.

2.1.52 *Epithermal Neutrons* — Neutrons of kinetic energy greater than that of thermal agitation; the term is often restricted to energies just above thermal, that is, energies comparable with those of chemical bonds.

2.1.53 *Thermal Neutrons* — Neutrons essentially in thermal equilibrium with the molecules of the medium in which they exist.

2.2 Interactions

2.2.1 *Disordering* — Displacement of an atom due to radiation from the position it occupies in a crystal lattice.

2.2.2 *Wigner Effect* — In reactor operation, the change in physical properties of graphite resulting from displacement of lattice atoms by high-energy neutrons and other energetic particles.

2.2.3 *Ionization* — Ion formation by the division of molecules or by the addition of electrons to or separation of electrons from atoms, molecules or formations of molecules.

2.2.4 *Total Ionization*

a) Total electric charge of ions of the same sign produced by a moving particle which has lost its entire kinetic energy in its path. Total ionization for a given gas is nearly proportional to the initial energy, and nearly independent of the nature of the ionizing particle. It is often used as a measure of the energy of a particle.

b) Total number of ion pairs produced by a charged particle along its trajectory.

2.2.5 *Primary Ionization* — In a counter tube, total ionization produced by the incident radiation prior to multiplication due to the gas.

2.2.6 *Specific Ionization or Linear Ionization (at a Point)* — The number of 10_n pairs produced in a given material by any radiation per unit length of its path.

2.2.7 *Photoelectric Effect*

a) Ejection of bound electrons of a system under the influence of incident photons, in which all the energy (h ν) of a photon is absorbed for every electron ejected.

b) Ejection of a bound electron from an atom when a photon collides with the atom, in which the entire energy is transferred to the bound electron.

c) The process in which a photon interacts with an atom transferring its entire energy to a bound electron which is subsequently ejected.

2.2.8 *Photonuclear Reaction* — Nuclear reaction resulting from the interaction between a photon and a nucleus.

2.2.9 *Nuclear Disintegration* — Transformation of the nucleus, involving a splitting into two or more nuclei or particles with emission of energy; this transformation can be spontaneous, or induced by a nucleus or a particle.

2.2.10 *Disintegration Constant* — Probability that a radioactive atom will disintegrate spontaneously in unit time.

2.2.11 *Disintegration Rate* — Number of disintegrations per unit time occurring in a radioactive substance.

NOTE — The activity concept having been defined for a pure radionuclide, that of disintegration rate is for use in the case of a mixture of radionuclides.

2.2.12 *Disintegration Energy* — Energy released in a nuclear disintegration.

2.2.13 *Radioactivity* — The property of certain nuclides whereby particles or gamma radiation are spontaneously emitted or whereby orbital electrons of the nuclide are captured.

2.2.14 *Natural Radioactivity* — Spontaneous radioactivity of natural elements.

2.2.15 *Induced Radioactivity* — Radioactivity caused by bombarding nuclides with particles or radiation.

2.2.16 *Radioactive Decay* — Transformation of a nuclide by spontaneous emission of particles with or without the emission of gamma radiation or by capture of an orbital electron of the nuclide.

2.2.17 *Activation* — Process of inducing radioactivity, for example, by neutron bombardment.

2.2.18 *Activity (of a Quantity of a Radioactive Nuclide)* (A) — The quotient of $\Delta N \div \Delta t$, where ΔN is the number of nuclear transformations which occur in this quantity in time Δt. $A = \Delta N / \Delta t$, where Δt is very small.

2.2.19 *Curie* (Ci) — The special unit of activity.

1 $Ci = 3{\cdot}7 \times 10^{10}$ disintegrations per second

2.2.20 *Specific Activity* — Nuclear activity per unit mass.

2.2.21 *Unit-Volume Activity* — Nuclear activity per unit volume.

2.2.22 *Activity Curve* — Curve representing the activity of a radioactive source as a function of time.

2.2.23 *Radioactive Half-Life* — For a single radioactive decay process the mean time required for the activity to decrease to half its value by that process.

2.2.24 *Exponential Decay (of a Quantity)* — Variation of the quantity A in accordance with the law:

$$A = A_0 e^{-\lambda t}$$

where

A and A_0 are the respective values of the quantity at times t and zero.
λ is a constant depending on the nature of A and on the process that causes it to decrease, sometimes referred to as the 'decay constant'.

2.2.25 *Mean Life* — The average lifetime for an atomic or nuclear system in a specified state. For an exponentially decaying system, the average time for the number of atoms or nuclei in a specified state to decrease by a factor of e.

2.2.26 *Neutron Diffusion* — A phenomenon in which neutrons in a medium through process of successive scattering collisions with the atoms or molecules of the medium tend to migrate from one region to another.

2.2.27 *Diffusion Coefficient for Neutron Flux Density* — The ratio of the neutron current density at a particular energy to the negative gradient of the neutron flux density at the same energy in the direction of that current.

2.2.28 *Build-up Factor* — In the passage of radiation through a medium, the ratio of the total value of a specified radiation quantity at any point to the contribution to that value from radiation reaching the point without having undergone a collision.

2.2.29 *Albedo (Neutron)* — The probability under specified conditions that a neutron entering into a region through a surface will return through that surface.

2.2.30 *Leakage* (*Reactor Theory*) — The net loss of neutrons from a region of a reactor by escape across the boundries of the region.

2.2.31 *Capture* — Any process by which an atomic or nuclear system acquires an additional particle.

2.2.32 *Radiative Capture* — Capture of an incident particle resulting in the emission of γ-rays.

2.2.33 *Resonance Level* — Energy level of a compound nucleus, giving rise to resonances.

2.2.34 *Resonance Capture* — Capture of an incident particle at a resonance level of the resultant compound nucleus.

2.2.35 *Neutron Absorption* — Nuclear interaction in which the incident neutron disappears as a free particle even when one or more neutrons are subsequently emitted accompanied by other particles, for example, in fission.

2.2.36 *Resonance Absorption* — Capture of an incident particle at a resonance level of the resultant compound nucleus.

2.2.37 *Attenuation* — The reduction of a radiation quantity upon passage of radiation through matter resulting from all types of interaction with the matter. The radiation quantity may be, for example, the particle flux density or the energy flux density (*see also* **2.2.38**).

2.2.38 *Geometric Attenuation* — The reduction of a radiation quantity due to the effect only of the distance between the point of interest and the source, excluding the effect of any matter present, (for example, the inverse square law for a point source).

2.2.39 *Attenuation Coefficient* — Of a substance, for a parallel beam of specified radiation, is the quantity μ in the expression $\mu \Delta x$ for the fraction removed by attenuation in passing through a thin layer of thickness Δx of that substance. It is a function of the energy of the radiation. According as Δx is expressed in terms of length, mass per unit area, or moles per unit area, μ is called the linear, mass or molar attenuation coefficient.

2.2.40 *Attenuation Factor* — For a given attenuating body in a given configuration, the factor by which a radiation quantity at some point of interest is reduced owing to the interposition of the body between the source of radiation and the point of interest.

2.2.41 *Absorption*

a) A phenomenon in which a beam of incident radiation transfers to the matter which it traverses some or all of its energy.

NOTE — The compton effect is considered to be part of the absorption process.

b) For a specified particle, an atomic or nuclear interaction in which the incident particle disappears as a free particle even when one or more of the same or different particles are subsequently emitted.

NOTE — Scattering is not considered to be a part of the absorption process.

2.2.42 *Exponential Absorption* — Decrease in radiation quantity (particle flux densities or energy flux density) of a beam of particles or photons during its passage through matter in accordance with the function:

$$I = I_0 \, e^{-\mu x}$$

where

I = the energy flux density of the beam,
x = measure of the amount of matter traversed,
I_0 = initial energy flux density, and
μ = appropriate absorption coefficient.

2.2.43 *Absorption Coefficient* — Of a substance, for a parallel beam of specified radiation, the quantity μ abs in the expression μ abs $\triangle x$ for the fraction absorbed in passing through a thin layer of thickness $\triangle x$ of that substance. It is function of the energy of the radiation. According as $\triangle x$ is expressed In terms of length, mass per unit area, or moles per unit area, μ abs is called the linear, mass or molar absorption coefficient.

NOTE — It is that part of the attenuation coefficient resulting from absorption processes only.

2.2.44 *Scattering* — A process in which a change in direction or energy of an incident particle is caused by a collision with a particle or a system of particles.

2.2.45 *Coherent Scattering* — A process in which radiation is scattered in such a manner that a definite phase relation exists between the scattered and incident waves.

2.2.46 *Incoherent Scattering* — A process in which radiation is scattered in such a manner that no definite phase relation exists between the scattered and incident waves.

2.2.47 *Elastic Scattering* — A scattering process in which the energy of a scattered particle is unchanged in the centre-of-mass system.

2.2.48 *Inelastic Scattering* — A scattering process in which the energy of a scattered particle is changed in the centre-of-mass system. This process can occur in either of the following ways:

a) *In radiative inelastic scattering* — Some of the kinetic energy of an incident particle in the centre-of-mass system goes into excitation of the target nucleus, followed by subsequent de-excitation through the emission of one or more photons.

b) *In thermal inelastic scattering* — Energy is exchanged between a slow neutron or any other particle and molecules or lattices resulting in their extranuclear excitation.

2.2.49 *Moderation* — The process by which neutron energy is reduced through scattering collisions.

2.2.50 *Nuclear Fusion Reaction* — A reaction between two light nuclei resulting in the production of at least one nuclear species heavier than either initial nucleus, together with excess energy.

2.2.51 *Mass Defect* — Difference between the sum of the masses of the nucleons forming the nucleus and the mass of the nucleus.

NOTE — Originally this expression meant the difference between the physical atomic mass and the mass number.

2.2.52 *Binding Energy*

a) *For a particle in a system* — The net energy required to remove it from the system.

b) *For a system* — The net energy required to decompose it into its constituent particles.

2.2.53 *Fertile* — Of a nuclide, capable of being transformed, directly or indirectly, into a fissile nuclide by neutron capture. Of a material, containing one or more fertile nuclides.

2.2.54 *Fissionable* — Of a nuclide, capable of undergoing fission by any process. Neutron capture is the most frequent cause of fission.

2.2.55 *Nuclear Fission* — The division of a heavy nucleus into two (or sometimes more) parts with masses of equal order of magnitude; usually accompanied by the emission of neutrons, gamma rays, and, sometimes small charged nuclear fragments.

2.2.56 *Neutron Multiplication* — The process in which a neutron when it is captured produces on the average through fission more than one neutron in a medium containing fissionable material.

2.2.57 *Fission Spectrum* — Energy distribution of fission neutrons.

2.2.58 *Fission Yield* — Ratio of the number of fissions leading to a given nuclide, in a direct manner or by disintegration of other primary fission products, to the total number of fissions. It may be expressed in percent.

2.2.59 *Primary Fission Yield, Direct Fission Yield or Independent Fission Yield* — Ratio of number of nuclei of a given nuclide directly produced in fission to the total.

2.2.60 *Cumulative Fission Yield* — The ratio of number of nuclei of a given nuclide, either directly or indirectly produced in fission up to a specified time, to the total. If no time is specified, the yield is considered to be the asymptotic value.

2.2.61 *Chain Fission Yield* — For a particular mass number is the sum of the independent fission yields for all isobars of that mass number.

2.2.62 *Fast Fission* — Fission caused by fast neutrons.

2.2.63 *Prompt Neutron Fraction* — The ratio of the mean number of prompt neutrons per fission to the mean total number of neutrons (prompt plus delayed) per fission.

2.2.64 *Delayed Neutron Fraction* — The ratio of the mean number of delayed neutrons per fission to the mean total number of neutrons (prompt plus delayed) per fission.

2.2.65 *Effective Delayed Neutron Fraction* — The ratio of the mean number of fission caused by delayed neutrons to the mean total number of fissions caused by delayed plus prompt neutrons.

NOTE — The effective delayed neutron fraction is generally larger than the actual delayed neutron fraction.

2.2.66 *Fissile* — Of a nuclide, capable of undergoing fission by interaction with thermal neutrons.

2.2.67 *Thermal Fission* — Fission caused by thermal neutrons.

2.3 Cross-Sections

2.3.1 *Cross-Section or Microscopic Cross-Section* — A measure of the probability of a specified interaction between an incident radiation and a target particle or system of particles. It is the reaction rate per target particle for a specified process divided by the flux density of the incident radiation (microscopic cross-section).

NOTE — Unless otherwise qualified the term 'Cross-Section' shall mean 'Microscopic Cross-Section'.

2.3.2 *Barn* — A unit of area used in expressing a nuclear cross-section (1 barn $= 10^{-24}$ cm^2).

2.3.3 *Macroscopic Cross-Section* — In reactor physics the term is applied to a specified group of target particles and implies sum of the cross-sections related to a certain type of interaction per unit volume of the target matter.

2.3.4 *Activation Cross-Section* — The cross-section for the formation of a radionuclide by a specified interaction.

2.3.5 *Differential Cross-Section* — The cross-section for an interaction process involving one or more outgoing particles with specified direction or energy per unit interval of solid angle or energy.

2.3.6 *Doppler-Averaged Cross-Section* — A cross-section averaged over energy, employing appropriate weighting factors, to take into account the effect of thermal motion of the target particles such that the product of the average cross-section so obtained and the flux density in the laboratory system gives the correct reaction rate.

2.3.7 *Thermal Cross-Section* — The cross-section for interaction by thermal neutrons.

NOTE — Since thermal neutrons have different energy distributions in different situations (for example, at different temperatures), this is not a precise term, and for this reason cross-sections for 2 200 m/s neutrons are commonly quoted.

2.3.8 *Effective Thermal Cross-Section or Westcott Cross-Section* — A fictitious cross-section for a specified interaction which when multiplied by the conventional flux density gives the correct reaction rate.

Note — The use of this term is usually restricted to capture and fission in well-moderated systems.

2.3.9 *Scattering Cross-Section* — The cross-section for the scattering process.

2.3.10 *Coherent Scattering Cross-Section* — The cross-section for the coherent scattering process.

2.3.11 *Incoherent Scattering Cross-Section* — The cross-section for the incoherent scattering process.

2.3.12 *Elastic Scattering Cross-section* — The cross-section for the elastic scattering process.

2.3.13 *Inelastic Scattering Cross-Section* — The cross-section for the inelastic scattering process.

2.3.14 *Radiative Inelastic Scattering Cross-Section* — The cross-section for the radiative inelastic scattering process.

2.3.15 *Thermal Inelastic Scattering Cross-Section* — The cross-section for the thermal inelastic scattering process.

2.3.16 *Transport Cross-Section* — The total cross-section less the product of the scattering cross-section and the average cosine of the scattering angle in the laboratory system. The reciprocal of the macroscopic transport cross-section is the transport mean free path.

2.3.17 *Group Transfer Scattering Cross-Section* — The weighted average 'cross-section', characteristic of the energy group structure, that will account for the transfer of neutrons by scattering from one specified group to another specified group. It is one element of the corresponding group transfer scattering matrix.

2.3.18 *Group Removal Cross-Section* — The weighted average 'cross-section', characteristic of an energy group, that will account for the removal of neutrons from that group by all processes.

2.3.19 *Nonelastic (Interaction) Cross-Section* — The difference between the total cross-section and the elastic scattering cross-section.

Note — The nonelastic cross-section is different from the inelastic scattering cross-section.

2.3.20 *Capture Cross-Section* — The cross-section for the capture process.

2.3.21 *Radiative Capture Cross-Section* — The cross-section for the radiative capture process.

2.3.22 *Neutron Absorption Cross-section* — The cross-section for the neutron absorption process. It is the difference between the total cross-section and the scattering cross-section.

2.3.23 *Fission Cross-Section* — The cross-section for the fission process.

2.3.24 *Alpha Ratio* — As applied to fissionable nuclei, the ratio of the radiative capture cross-section to the fission cross-section.

2.3.25 *Total Cross-Section* — The sum of the cross-sections for all the separate interactions between the incident radiation and a specified target.

3. REACTOR THEORY

3.1 Expressions Relating to Neutrons

3.1.1 *Mean Free Path* — The average distance that particles of a specified type travel before a specified type (or types) of interaction in a given medium. The mean free path may thus be specified for all interactions (such as total mean free path) or for particular types of interaction such as scattering, capture or ionization.

3.1.2 *Transport Mean Free Path* — The reciprocal of the macroscopic transport cross-section.

3.1.3 *Slowing-Down Area* — One-sixth of the mean square distance travelled by neutrons in an infinite homogeneous medium from their points of origin to the points where they have been slowed down from the initial energy to a specified energy.

3.1.4 *Slowing-Down Length* — The square root of the slowing-down area.

3.1.5 *Diffusion Area* — One-sixth of the mean square distance travelled by a particle of a given type and class from appearance to disappearance (within the type and class) in an infinite homogeneous medium.

3.1.6 *Diffusion Length* — The square root of the diffusion area.

3.1.7 *Migration Area* — The sum of the slowing-down area from fission energy to thermal energy and the diffusion area for thermal neutrons.

3.1.8 *Migration Length* — The square root of the migration area.

3.1.9 *Lethargy* — The natural logarithm of the ratio of a reference energy to the energy of a neutron.

3.1.10 *Average Logarithmic Energy Decrement* — The mean value of the increase in lethargy per neutron collision.

3.1.11 *Slowing-Down Power* — For a given medium, the product of the average logarithmic energy decrement and the macroscopic neutron scattering cross-section.

3.1.12 *Neutron Energy Group* — One of a set of groups consisting of neutrons having energies within arbitrarily chosen intervals. Each group may be assigned effective values for the characteristics of the neutrons within the group.

3.1.13 *Multigroup Model* — A model which divides the neutron population into a finite number of energy groups with each group being assigned a single effective energy.

3.1.14 *Generation Time* — The mean time required for neutrons arising from fission to produce other fissions.

3.1.15 *Neutron Cycle* — The average energy, interaction and migration history of neutrons in a reactor, beginning with fission and continuing until they have leaked out or have been absorbed.

3.1.16 *Neutron Economy* — Balance account, in a reactor, of the neutrons created and the neutrons lost, and problems related thereto.

3.1.17 *Beam* — A unidirectional, or nearly unidirectional, flow of electromagnetic radiation or of particles.

3.1.18 *Neutron or Particle Current Density* — A vector such that its component along the normal to a surface equals the net number of particles crossing that surface in the positive direction per unit area per unit time.

3.1.19 *Neutron (Number) Density* — The number of free neutrons per unit volume. Partial densities may be defined for neutrons characterized by such parameters as energy and direction.

3.1.20 *Particle Fluence or Fluence* — At a given point in space, the number of particles or photons incident during a given time interval on a sphere of unit area. It is identical with the time integral of the flux density.

3.1.21 *Particle Flux Density* (φ) *or Flux* — At a given point in space, the number of particles or photons incident per unit time on a sphere of unit area. It is identical with the product of the particle density and the average speed. The term is commonly called 'Flux'.

3.1.22 *Radiant Energy Flux Density* (I) — At a given point in space, the quantity of energy per unit time entering on a sphere of unit area.

3.1.23 *Conventional Flux Density or* 2 200 *Metre per second Flux Density* —A fictitious flux density equal to the product of the total number of neutrons per cubic centimetre and a neutron speed of $2{\cdot}2 \times 10^5$ centimetres per second.

3.1.24 *Age*

a) One-sixth of the normalized second spatial moment of the neutron flux density (flux age) at energy E, or the neutron slowing-down density past energy E (slowing-down age), for a point isotropic neutron source, that is

$$\tau\,(E) = \frac{1}{6}\,\frac{\int_0^\infty r^2 f(E, r)\, r^2 dr}{\int_0^\infty f(E, r)\, r^2 dr}$$

where

r = radial distance from the source, and

$f(E, r)$ = either the neutron flux density or the neutron slowing-down density as appropriate.

b) When Fermi age theory of slowing-down is applicable, the value of the age is given by the following expression for the Fermi age (for a monoenergetic source at energy E_0),

$$\tau(E, E_0) = \int_{E}^{E_0} \frac{D(E')}{xi\Sigma_s(E')} \frac{dE'}{E'}$$

where

E' = the neutron energy,
D = diffusion coefficient of neutron flux density,
xi = average logarithmic energy decrement, and
Σ_s = scattering cross section per unit volume.

3.1.25 *Disadvantage Factor* — In a reactor cell, the ratio of the average neutron flux density in a material to that in the fuel. Usually, the term refers to the moderator material and to the thermal neutron flux density.

3.2 Expressions Relating to Reactors

3.2.1 *Nuclear Energy* — Energy released in nuclear reactions or transitions.

3.2.2 *Nuclear Chain Reaction (or Convergent Reaction)* — A series of successive similar nuclear reactions in which every reaction in every generation gives rise to one or more agents which can trigger subsequent similar reactions.

3.2.3 *Divergence* — Growth of a reaction rate with time.

3.2.4 *Reactor Time Constant or Reactor Period* — The time required for the neutron flux density in a reactor to change by a factor of *e* (2·718...).

NOTE — The term 'Reactor time constant' is preferred to 'Reactor period'.

3.2.5 *Critical* — State of a nuclear chain reacting medium when its effective multiplication factor equals unity. (A reactor is critical when the rate of neutron production, excluding neutron sources whose strengths are not a function of fission rate, is equal to the rate of neutron loss.)

3.2.6 *Prompt Critical* — State of a nuclear chain reacting medium when rendered critical by the use of prompt neutrons only.

3.2.7 *Delayed Critical* — State of a nuclear chain reacting medium when rendered critical predominantly by the use of delayed neutrons.

3.2.8 *Critical Experiment* — A test or series of tests performed with an assembly of reactor materials which can be gradually brought to the critical state for the purpose of determining the nuclear characteristics of a reactor. The experiment is usually performed at very low power.

3.2.9 *Critical Equation* — Any equation relating parameters of an assembly which shall be satisfied for the assembly to be critical.

3.2.10 *Critical Mass* — The minimum mass of fissile material which will sustain a nuclear chain reaction for a specified geometrical arrangement and material composition.

3.2.11 *Critical Size* — The minimum physical dimensions of a reactor core or an assembly which can be made critical for a specified geometrical arrangement and material composition.

3.2.12 *Relative Importance* — For neutrons of type 'A' relative to neutrons of type 'B', the average number of neutrons with velocity and position 'B' which shall be added to a critical system to keep the chain reaction rate constant after removal of a neutron with velocity and position 'A'.

3.2.13 *Importance Function* — In a critical system, the average asymptotic number of neutrons in the system descended from a neutron of a given position and velocity. It is proportional to the adjoint of the neutron flux density.

3.2.14 *Iterated Fission Expectation* — In a critical reactor, the average value of the number of fissions per generation arising from neutrons of subsequent generations of a given neutron. Frequently called 'Iterated Fission Probability'.

3.2.15 *Multiplication (Subcritical)* — Given a subcritical assembly of reactor materials, the subcritical multiplication factor is the ratio of the number of neutrons maintained in the system by a neutron source to the number that would be maintained if the fissions were suppressed without making any other changes in the materials.

3.2.16 *Exponential Experiment* — An experiment, performed with a subcritical assembly of reactor materials and an independent neutron source, used to determine the neutron characteristics of a configuration of these materials. With the usual placement of the neutron source (that is, thermal neutrons introduced through one face of a cube or end of a cylinder) the neutron flux density in the assembly decreases exponentially with distance from the boundary adjacent to the source.

3.2.17 *Exponential Assembly* — A subcritical assembly used for an exponential experiment.

3.2.18 *Material Buckling* — A parameter, B^2_m, providing a measure of the multiplying properties of a medium as a function of the materials and their disposition. In age-diffusion theory B^2_m is the value of B^2 satisfying the equation:

$$ke^{-B^2\tau} = 1+B^2L^2$$

where

k = infinite multiplication factor,
τ = the age, and
L = diffusion length of the neutrons.

NOTE — The equation is derived from one group theory.

3.2.19 *Geometric Buckling* — A parameter, B^2_g depending on the shape and the external dimensions of an assembly, for example, a reactor core. For a bare reactor, the constant B^2_g is given by the equation:

$$\nabla^2 \varphi(r)+B^2\varphi(r) = 0$$

where

r = the radius vector, with the condition that the neutron flux density $\varphi(r)$ is zero at the extrapolated boundary of the assembly.

3.2.20 *Multiplication Factor* — The ratio of the total number of neutrons produced during a time interval (excluding neutrons produced by sources whose strengths are not a function of fission rate) to the total number of neutrons lost by absorption and leakage during the same interval. When the quantity is evaluated for an infinite medium or for an infinite repeating lattice it is referred to as the infinite multiplication factor (k_{00}), and when the quantity is evaluated for a finite medium it is referred to as the effective multiplication factor (k_{eff}). Also called 'multiplication constant'.

3.2.21 *Infinite Multiplication Constant* — *See* **3.2.20.**

3.2.22 *Effective Multiplication Constant* — *See* **3.2.20.**

3.2.23 *Eta Factor* — The average number of fission neutrons (including delayed neutrons) emitted per neutron absorbed. It is a function of the energy of the absorbed neutrons. The term may be applied to a fissionable nuclide or to a nuclear fuel, as specified.

3.2.24 *Fast Fission Factor* — In an infinite medium, the ratio of the mean number of neutrons produced by fissions due to neutrons of all energies, to the mean number of neutrons produced by thermal fissions only.

3.2.25 *Reactivity* — A parameter, ρ, giving the deviation from criticality of a nuclear chain reacting medium. Positive values correspond to a supercritical state and negative values to a subcritical state.

Quantitatively

$$\rho = 1 - \frac{1}{k_{eff}}$$

where k_{eff} is the effective multiplication factor.

3.2.26 *Reactivity Temperature Coefficient* — The partial derivative of reactivity with respect to temperature.

NOTE — The temperature may be specified for some location or component.

3.2.27 *Burn-Up* — Nuclear transformation of reactor materials by neutron absorption during reactor operation. The term may be specified to fuel or other materials.

3.2.28 *Burn-Up Fraction* — The fraction, usually expressed as a percentage, of an initial quantity of nuclei of a given type which has undergone burn-up.

3.2.29 *Specific Burn-Up or Fuel Irradiation Level* — The total energy that has been released per unit mass of fissile and fertile material. Usually expressed in 'megawatt days per tonne'.

3.2.30 *Specific Power* — The power produced per unit mass of fuel in a reactor.

3.2.31 *Depletion* — Reduction of the concentration of one or more specified isotopes in a material.

3.2.32 *Enrichment* — The process by which the contents of a specified isotope in an element is increased.

NOTE — Enrichment has also been taken to mean:

a) isotopic abundance,
b) enrichment factor, and
c) enrichment factor minus one (*degree of enrichment*). These usages should be avoided.

3.2.33 *Conversion* (*Reactor Technology*) — Nuclear transformation of a fertile substance into a fissile substance.

3.2.34 *Conversion Ratio* — The ratio of the number of fissile nuclei produced by conversion to the number of fissile nuclei destroyed. The term can refer to an instant of time or to a period of time.

3.2.35 *Breeding* — Conversion when the conversion ratio is greater than unity.

3.2.36 *Breeding Ratio* — The conversion ratio when it is greater than unity.

3.2.37 *Breeding Gain* — Breeding ratio minus one.

4. REACTOR TECHNOLOGY AND WORKING

4.1 Reactors

4.1.1 *Nuclear Reactor or Pile* — A device in which a self-sustaining nuclear fission chain reaction can be maintained and controlled (fission reactor). The term is sometimes applied to a device in which a nuclear fusion reaction can be produced and controlled (fusion reactor).

4.1.2 *Homogeneous Reactor* — A reactor in which the core materials are distributed in such a manner that its neutron characteristics can be accurately described by the assumption of homogeneous distribution of the materials throughout the core.

4.1.3 *Heterogeneous Reactor* — A reactor in which the core materials are segregated to such an extent that its neutron characteristics can not be accurately described by the assumption of homogeneous distribution of the materials throughout the core.

4.1.4 *Natural Uranium Reactor* — Reactor fed with natural uranium.

4.1.5 *Enriched Reactor* — Reactor fed with a nuclear fuel obtained from natural uranium, enriched with uranium 235, or with any other fissile matter (uranium 233, plutonium, etc) added to it.

4.1.6 *Plutonium Reactor* — Reactor fed with fissile fuel of which plutonium is the main fissile matter.

4.1.7 *Fluidized Reactor* — Reactor using a fuel of which certain characteristics are very nearly those of a fluid.

4.1.8 *Circulating Reactor* — Nuclear reactor in which the fissile matter circulates through the core. Usually this means using fissile matter in fluid form or in the form of small particles in suspension in a fluid.

4.1.9 *Fast Reactor* — A reactor in which fission is induced predominantly by fast neutrons.

4.1.10 *Intermediate Reactor or Intermediate Spectrum Reactor* — A reactor in which fission is induced predominantly by intermediate neutrons.

4.1.11 *Epithermal Reactor* — A reactor in which the fission is induced predominantly by epithermal neutrons.

4.1.12 *Thermal Reactor* — A reactor in which fission is induced predominantly by thermal neutrons.

4.1.13 *Converter Reactor* — A reactor whose purpose is to convert a fertile material into a fissionable material.

4.1.14 *Breeder Reactor* — A reactor which produces more fissile material than it consumes, that is, has a conversion ratio greater than unity.

4.1.15 *Spectral Shift Reactor* — A reactor in which, for control or other purposes, the neutron spectrum may be adjusted by varying the properties or amount of moderator.

4.1.16 *Power Reactor* — A reactor whose primary purpose is to produce power. Reactors in this class include:

a) electricity production reactor,
b) propulsion reactor, and
c) heat-production reactor.

4.1.17 *Research Reactor* — A reactor of any power level used primarily as a research tool for basic or applied research. Reactors in this class include:

a) low-flux research reactor,
b) high-flux research reactor,
c) pulsed reactor,
d) testing reactor, and
e) zero-power reactor (may also be an experimental reactor).

4.1.18 *Experimental Reactor* — A reactor operated primarily to obtain reactor physics or engineering data for the design or development of a reactor or reactor type. Reactors in this class include:

a) zero-power reactor (may also be a research reactor),
b) reactor experiment, and
c) prototype reactor.

4.1.19 *Production Reactor* — A reactor whose primary purpose is to produce fissile or other materials or to perform irradiation on an industrial scale.

Unless otherwise specified the term usually refers to a plutonium-production reactor. Reactors in this class include:

a) fissile-material production reactor,
b) isotope-production reactor, and
c) irradiation reactor.

4.1.20 *Training Reactor* — A reactor operated primarily for training in reactor operation and instructing in reactor behaviour.

4.2 Constituent Parts

4.2.1 *Nuclear Fuel* — Material containing fissile nuclides which when placed in a reactor enables a chain reaction to be achieved.

4.2.2 *Enriched Material* — Material in which the concentration of one or more specified isotopes of a constituent is greater than its natural value.

4.2.3 *Depleted Material* — Material which has undergone depletion.

4.2.4 *Fuel Element or Fuel Rod* — The smallest structurally discrete part of a reactor which has fuel as its principal constituent.

4.2.5 *Slug* — A small fuel element of cylindrical form.

4.2.6 *Fuel Assembly* — A fuel element or a group of fuel elements in the form of cluster of rods or a bundle of plates, with all its accessories.

4.2.7 *Cladding or Can* — An external layer of material applied, usually to a nuclear fuel, to provide protection from a chemically reactive environment, to provide containment of radioactive products produced during the irradiation of the composite, or to provide structural support.

4.2.8 *Plug*

a) Piece of material used for plugging a hole in a screen of protective material so as to prevent the passage of radiations.

b) A part welded to the cladding, so as to make it efficiently radiation proof.

4.2.9 *Channel* — Duct provided in a reactor.

4.2.10 *Charge* — The fuel placed in a reactor.

4.2.11 *Active Core* — Medium inside which chain fissions can take place.

4.2.12 *Core* — That region of a reactor in which a chain reaction can take place.

4.2.13 *Cell (Reactor)* — One of a set of elementary regions in a heterogeneous reactor each, of which has the same geometrical form and neutron characteristics as the other.

4.2.14 *Reactor Lattice* — An array of fuel and other materials arranged according to a regular pattern.

4.2.15 *Blanket* — A region of fertile material placed around or within the core of a reactor for the purpose of conversion.

4.2.16 *Irradiation Channel* — A hole through a reactor shield into the interior of the reactor in which irradiations are carried out. Sometimes called experimental hole.

4.2.17 *Beam Hole* — A hole through a reactor shield into the interior of the reactor for the passage of a beam of radiation for experiments outside the reactor.

4.2.18 *Moderator* — A material used to reduce by scattering collisions and without appreciable capture of the kinetic energy of neutrons.

4.2.19 *Reflector* — A material or a body of material which reflects incident radiation. In nuclear reactor technology, this term is usually restricted to designate a part of a reactor placed adjacent to the core for the purpose of returning some of the escaping neutrons to the core by means of scattering collisions.

4.2.20 *Secondary Coolant Circuit* — A circulating system used to remove heat from the primary coolant circuit.

4.2.21 *Containment* — The prevention of release, even under the conditions of a reactor accident, of unacceptable quantities of radioactive material beyond a controlled zone. Also, commonly, the containing system itself.

4.2.22 *Shield* — A body of material intended to reduce the intensity of radiation entering a region.

4.2.23 *Thermal Shield* — A shield intended to reduce heat generation by ionizing radiation in, and heat transfer to exterior regions.

4.2.24 *Biological Shield* — A shield whose prime purpose is to reduce ionizing radiation to biologically permissible levels.

4.2.25 *Extrapolated Boundary* — A hypothetical surface outside an assembly on which the neutron flux density would be zero if the flux existing a few mean free paths from the physical surface were extrapolated.

4.2.26 *Reactor Vessel* — The principal vessel surrounding at least the reactor core.

4.2.27 *Neutron Converter* — A device placed in a flux of slow neutrons to produce fast neutrons.

4.3 Reactor Operation

4.3.1 *Radiation Source* — An apparatus or a material emitting or capable of emitting ionizing radiation.

4.3.2 *Radioactive Source* — Any quantity of radioactive material which is intended for use as a source of ionizing radiation.

4.3.3 *Sealed Source* — A hermetically encapsulated radioactive source.

4.3.4 *Source Range* — The range of reactor operation within which a supplementary neutron source is required to facilitate the measurement of neutron flux density.

4.3.5 *Counter Range* — The range of reactor power level within which a particle counter is required for adequate measurement of the neutron flux density.

4.3.6 *Operating Range* — The range of reactor power level within which a reactor is designed to operate in a steady-state condition.

4.3.7 *Power Range* — The range of power level within which the control of a reactor is primarily based upon measurement of temperature or neutron flux density rather than time constant (period).

4.3.8 *Time Constant Range or Period Range* — The range of power level within which the reactor time constant (reactor period) rather than reactor power, is of primary importance for reactor control.

4.3.9 *Reactor Regulation* — Sequence of operations for the purpose of starting up the reactor and keeping it at the desired power level.

4.3.10 *Reactor Control* — The intentional variation of the reaction rate in a reactor, or the adjustment of reactivity to maintain steady-state operation.

4.3.11 *Configuration Control* — Reactor control by changing its configuration.

4.3.12 *Fuel Control* — Control of a reactor by adjustment of the properties, position, or quantity of fuel in such a way as to change the reactivity.

4.3.13 *Moderator Control* — Control of a reactor by an adjustment of the properties, position or quantity of the moderator in such a way as to change the reactivity.

4.3.14 *Spectral Shift Control* — A special type of moderator control.

4.3.15 *Absorption Control* — Control of a reactor by adjustment of the properties, position, or quantity of neutron-absorbing material, other than fuel, moderator and reflector material, in such a way as to change the reactivity.

4.3.16 *Neutron Absorber (Material)* — A material with which neutrons interact significantly by reactions resulting in their disappearance as free particles.

4.3.17 *Neutron Absorber (Object)* — An object with which neutrons interact significantly or predominantly by reactions resulting in their disappearance as free particles without production of other neutrons.

4.3.18 *Poison* — A substance, which, owing to its high absorption cross section, reduces the reactivity of a reactor.

4.3.19 *Burnable Poison* — Poison purposely included in a reactor to help control long-term reactivity changes by its progressive burn-up.

4.3.20 *Xenon Effect* — Phenomenon that takes place in thermal reactors due to a build up of xenon which is a very important nuclear poison.

4.3.21 *Fluid Poison Control* — Control of a reactor by adjustment of the position, or quantity of a fluid nuclear poison in such a way as to change the reactivity. The fluid poison may include soluble chemicals or particles in suspension.

4.3.22 *Reflector Control* — Control of a reactor by adjustment of the properties, position, or quantity of the reflector in such a way as to change the reactivity.

4.3.23 *Self-Regulation* — An inherent tendency under certain conditions of a reactor to operate at a constant power level because of the effect on reactivity of a change in power level.

4.3.24 *Control Member or Control Element* — A movable part of a reactor which itself affects reactivity and is used for reactor control.

4.3.25 *Control Rod* — A control member in the form of a rod.

4.3.26 *Control Drive* — A device used for moving a control member in the course of reactor control.

4.3.27 *Coarse Control Member or Coarse Control Element* — A control member used for gross adjustment of the reactivity of a reactor or for altering flux distribution.

4.3.28 *Fine Control* — Fine regulation for the purpose of correcting reactivity drift of small amplitude.

4.3.29 *Fine Control Member or Fine Control Element or Regulating Member or Regulating Element* — A control member used for small and precise adjustment of the reactivity of a reactor.

4.3.30 *Coarse Control (Shimming)* — Coarse regulation for the purpose of correcting reactivity drift of major amplitudes spreading over a long period.

4.3.31 *Shim Member or Shim Element* — A control member used to compensate for long-term reactivity and flux density distribution effects in a reactor.

4.3.32 *Emergency Shutdown or Scram* — The act of shutting down a reactor suddenly to prevent or minimize a dangerous condition.

4.3.33 *Emergency Shutdown Rod* — Safety member for immediate action if required.

4.3.34 *Safety Member* — A control member which, singly or in concert with others, provides a reserve of negative reactivity for the purpose of emergency shutdown of a reactor.

4.3.35 *Reactor Safety Fuse* — A self-contained device designed to respond to excessive temperature or flux in a reactor and to act to reduce the reaction rate to a safe level. The device may or may not contain stored energy to facilitate its operation.

4.3.36 *Leakage* (*Shielding*) — Escape of radiation through a shield, especially by way of holes or cracks through the shield.

4.3.37 *Radioactive Contamination* — A radioactive substance dispersed in materials or places where it is undesirable.

4.3.38 *Decontamination Factor* — The ratio of the initial concentration of contamination of radioactive material to the final concentration arrived at through a process of decontamination. (The term may refer to a specified nuclide or to gross measurable radioactivity.)

4.4 Maintenance

4.4.1 *Irradiation* — Radiation exposure.

4.4.2 *Radioactive Material* — A material of which one or more constituents exhibit radioactivity.

NOTE — For special purposes such as regulation, this term may be restricted to radioactive material with an activity or a specific activity greater than a specified value.

4.4.3 *Radiation Damage* — Deleterious changes in the physical or chemical properties of a material as a result of exposure to ionizing radiation.

4.4.4 *Radioactive Waste* — Unusable radioactive materials obtained in the processing or handling of radioactive materials.

4.4.5 *After-Heat*

a) For a shut-down reactor, the heat resulting from residual radioactivity and fission.

b) For reactor fuel or reactor components after removal from the reactor, the heat resulting from residual radioactivity.

4.4.6 *Hot* — An expression commonly used to mean 'highly radioactive'.

4.4.7 *Fuel Burn-Out* (*Reactor Technology*) — In reactor technology, severe local damage of a fuel element, due to failure of the coolant to dissipate all the heat produced in the element.

4.4.8 *Slug Burst* — Occurrence of a leakage in the cladding.

4.4.9 *Loading* — Introduction of the nuclear fuel into the reactor.

4.4.10 *Fuel Charging Machine* — Apparatus for introducing the fuel into the reactor.

4.4.11 *Fuel Discharging Machine* — Apparatus for extracting the fuel from a reactor.

4.4.12 *Cask* — A shielded container used to store or transport radioactive material.

4.4.13 *Fuel Cooling Installation* — A large container or cell, usually filled with water, in which spent nuclear fuel is set aside until its radioactivity has decreased to a desired level.

4.4.14 *Fuel Reprocessing* — The processing of nuclear fuel, after its use in a reactor, to remove fission products and recover fissile and fertile material.

4.4.15 *Filter* — Absorbing matter through which radioactive material is passed to remove the absorbable constituents.

4.4.16 *Cladding* (*Process*) — The process of providing a material with a cladding.

4.4.17 *Canning* (*Process*) — The process of providing a material with a can.

APPENDIX A

(*Clause* 0.3)

PARTS OF IS : 1885 ELECTROTECHNICAL VOCABULARY

IS : 1885 (Part I)-1961 Electrotechnical vocabulary: Part I Fundamental definitions

IS : 1885 (Part II)-1961 Electrotechnical vocabulary: Part II Machines and transformers

IS : 1885 (Part III/Sec 1)-1965 Electrotechnical vocabulary: Part III Acoustics: Section 1 Physical acoustics

IS : 1885 (Part IV/Sec 1)-1965 Electrotechnical vocabulary: Part IV Electron tubes and valves: Section 1 Receiving valves

IS : 1885 (Part IV/Sec 2)-1965 Electrotechnical vocabulary: Part IV Electron tubes and valves: Section 2 X-ray tubes

IS : 1885 (Part V)-1965 Electrotechnical vocabulary: Part V Quartz crystals

IS : 1885 (Part VI)-1965 Electrotechnical vocabulary: Part VI Printed circuits

IS : 1885 (Part VII)-1965 Electrotechnical vocabulary: Part VII Semiconductor devices

IS : 1885 (Part VIII)-1965 Electrotechnical vocabulary: Part VIII Secondary cells and batteries

IS : 1885 (Part IX)-1966 Electrotechnical vocabulary: Part IX Electrical relays

*IS : 1885 (Part X)- Electrotechnical vocabulary: Part X Electrical protection

IS : 1885 (Part XI)-1966 Electrotechnical vocabulary: Part XI Electrical measurements

IS : 1885 (Part XII)-1966 Electrotechnical vocabulary: Part XII Ferromagnetic oxide materials

IS : 1885 (Part XIII/Sec 2)-1967 Electrotechnical vocabulary: Part XIII Telecommunication transmission lines and waveguides: Section 2 Microwave transmission lines and waveguides.

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*Under preparation.

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NOTE — This index has been prepared in accordance with IS : 1275-1958*. Index numbers are clause numbers.

irt=in relation to

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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